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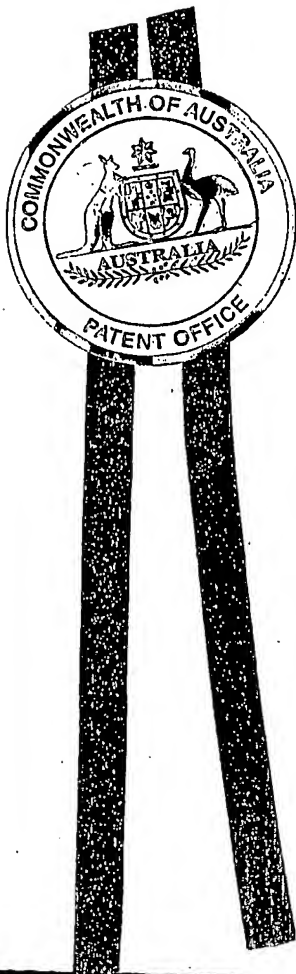
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I, LEANNE MYNOTT, MANAGER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2004900084 for a patent by ADRIAN MENZELL as filed on 08 January 2004.

I further certify that the above application is now proceeding in the name of SAVE THE WORLD AIR, INC. pursuant to the provisions of Section 113 of the Patents Act 1990.



WITNESS my hand this
Fourteenth day of January 2005

A handwritten signature, appearing to be 'L. Mynott', written in ink.

LEANNE MYNOTT
MANAGER EXAMINATION SUPPORT
AND SALES

IMPROVEMENTS IN OR RELATING TO EMISSION CONTROL SYSTEMS

Field of Invention

This invention relates to methods and means for controlling emissions
5 from internal combustion engines.

Background Art

The main emissions of combustion engines are:

- **Nitrogen gas (N₂)** - Air is 78-percent nitrogen gas, and most of this
10 passes right through the car engine.
- **Carbon dioxide (CO₂)** - This is one product of combustion. The
carbon in the fuel bonds with the oxygen in the air.
- **Water vapor (H₂O)** - This is another product of combustion. The
hydrogen in the fuel bonds with the oxygen in the air.

15 These emissions are mostly benign (although carbon dioxide emissions
are believed to contribute to global warming). But because the combustion process is
never perfect, some smaller amounts of more harmful emissions are also produced in
car engines:

- **Carbon monoxide (CO)** - a poisonous gas that is colorless and
20 odorless
- **Hydrocarbons or volatile organic compounds (VOCs)** - produced
mostly from unburned fuel that evaporates
- **Nitrogen oxides (NO and NO₂, together called NO_x)** - contributes to
smog and acid rain, and also causes irritation to human mucus
25 membranes

These are the three main regulated emissions, and also the ones that
catalytic converters are designed to reduce.

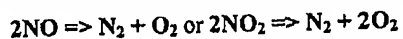
Modern cars are equipped with two-way and three-way catalytic
converters. This means that they aim to reduce three types of emissions (listed above).
30 CO, VOCs, NO_x

The converter uses two different types of catalysts, a **reduction**
catalyst and an **oxidization catalyst**. Both types consist of a ceramic structure coated

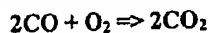
with a metal catalyst, usually platinum, rhodium and/or palladium. The idea is to create a structure that exposes the maximum surface area of catalyst to the exhaust stream, while also minimizing the amount of catalyst required (they are very expensive).

5 There are two main types of structures used in catalytic converters -- honeycomb and ceramic beads. Most cars today use a honeycomb structure.

 The reduction catalyst is the first stage of the catalytic converter. It uses platinum and rhodium to help reduce the NOx emissions. When an NO or NO₂ molecule contacts the catalyst, the catalyst rips the nitrogen atom out of the molecule and holds on to it, freeing the oxygen in the form of O₂. The nitrogen atoms bond
10 with other nitrogen atoms that are also stuck to the catalyst, forming N₂. For example:



 The oxidation catalyst is the second stage of the catalytic converter. It reduces the unburned hydrocarbons and carbon monoxide by burning (oxidizing) them
15 over a platinum and palladium catalyst. This catalyst aids the reaction of the CO and hydrocarbons with the remaining oxygen in the exhaust gas. For example:



 To operate efficiently, catalytic converters need to reach and maintain certain temperatures and in some operating conditions when an engine is idling or
20 when a vehicle is in stop/start traffic, temperatures fall off making the converters inoperable or lessening the efficiency of same.

 It is a general objective of the present invention to provide methods and apparatus for reducing emissions from internal combustion engines.

 Further objects and advantages of the present invention will become
25 apparent from the ensuing description.

Disclosure of Invention

 According to the broadest aspect of the present invention, there is provided a method of reducing emissions from an internal combustion engine
30 including the step of positioning a catalytic converter in an exhaust system downstream of a muffler in the system.

 The catalytic converter may be installed in a system which includes a

further catalytic converter upstream of the muffler.

The catalytic converter may include an elongate metal tube housing a honeycomb structure.

5 The catalytic converter may form the end section of an exhaust system or be interposed between a muffler and the end section of an exhaust system.

In an application of the present invention to small engines, a catalytic converter may be fitted within a tube extending from the exhaust outlet of a muffler.

The tube may extend partially into the muffler.

The end of the tube may be fitted with a deflecting baffle device.

10 In a further form of the present invention, a catalytic converter is positioned between the engine output and the exhaust of a marine outboard motor.

According to yet a further aspect of the present invention, there is provided a method of reducing emissions from an internal combustion engine including the step of positioning a catalytic converter in an exhaust system
15 downstream of a muffler wherein the catalytic converter is housed within a tube, a section of which incorporates a hinged flap which is capable of varying exhaust output flow rates depending on the mode of operation of the engine.

The flap may be weighted to suit various engine types and applications.

20 The distal end of the tube may be raked and the flap hinged to an upper region of the tube so that it closes off the tube when an engine is not operating.

Brief Description of the Drawings

Aspects of the present invention will now be described with reference to the accompanying drawings in which;

25 Figure 1 is a side view of a typical catalytic converter as is known in the art and is marked "prior art" accordingly, and

Figure 2 is a diagrammatic block diagram of an emission control system as is known in the prior art, and

30 Figure 3 is a diagrammatic block diagram of an emission control system according to the present invention, and

Figure 4 is a perspective drawing of a catalyst device in accordance with one possible embodiment of the present invention, and

Figure 4a is a side view of a catalyst device in accordance with a further possible embodiment of the present invention, and

Figure 5 is a side view of a small motor muffler assembly having a catalytic converter, and

5 Figures 5a and 5b are end and sectional views of the converter of figure 5, and

Figure 6 is a side view of a small motor muffler assembly according to a further aspect of the present invention, and

10 Figure 7 is a side view of a further small motor assembly according to another aspect of the present invention.

Figure 8 is a diagrammatic side view of a marine outboard motor incorporating a catalytic converter in accordance with another aspect of the present invention.

15 Figure 9 is a side view of a fitting including a catalytic converter in accordance with a further aspect of the present invention.

Figure 10 is an end of the fitting of Figure 9.

Figure 11 is a side view of a muffler outlet including a catalytic converter in accordance with a further aspect of the present invention.

20 With respect to the drawings, a typical catalytic converter as is known in the art and generally indicated by arrow 1 is designed to be interposed between an engine and a muffler associated with the engine. The converter typically comprises an inlet 1, a body 3 and an outlet 4.

Within the body 2 there is provided a reduction catalyst A and oxidation catalyst B and honeycombs C.

25 The catalytic converter 1 is interposed between an engine 5 and a muffler 6 of the an emission system as is indicated by figure 2.

According to the present invention and as illustrated by figure 3 a further converter device 7 is positioned downstream from the muffler 6 in a system.

30 The following test results indicate a surprising improvement in emission outputs as a result of the positioning of a downstream converter according to the present invention.

5

TEST ONE

CO ₂	13.76	CO	0.27
%		%	
O ₂	1.89	Eff	98.49
%		%	
Hexane	81	MRP	14.60
ppm		In Hg	
NO _x	980	LDA	1.08
ppm		—	

5

TEST TWO

CO ₂	14.15	CO	0.03
%		%	
O ₂	1.64	Eff	99.55
%		%	
Hexane	73	MRP	14.54
ppm		In Hg	
NO _x	873	LDA	1.08
ppm		—	

TEST THREE

CO ₂	13.80	CO	0.03
%		%	
O ₂	2.88	Eff	99.76
%		%	
Hexane	25	MRP	14.75
ppm		In Hg	
NO _x	877	LDA	1.14
ppm		—	

5 TEST ONE was carried out on a system not having a catalytic converter. It is noted that of the content of exhaust emissions, the CO (carbon monoxide), Hexane (hydro carbon/unburnt fuel) and NO_x (nitrogen oxides) are deemed to be undesirable pollutants. In all situations, if a system is able to reduce CO Hexane and NO_x emissions CO₂ emissions will rise as a consequence.

10 TEST TWO was carried out on a system including a catalytic converter of minimal length positioned downstream from the exhaust. It is noted that in test two, CO, Hexane and NO_x are reduced and CO₂ has risen marginally.

15 TEST THREE was carried out on a system similar to test two with a full length catalytic converter positioned downstream of the exhaust. In test three, the same CO result was obtained, a substantial reduction in Hexane was achieved and a minor change in NO_x was noted.

The catalytic converter of the present invention as illustrated by figure 4 comprises a metal open ended tube of a generally circular cross-section which encloses a honeycomb core 9. The tube 8 may have one or more air vents 9.

20 The converter 7 may be provided in a number of lengths and widths depending on the application.

The tube 8 can be readily adapted for fitment to an exhaust pipe and in

some applications e.g. smaller engines it may be fitted directly to an outlet manifold.

Figure 4a of the drawings illustrates a further form of converter according to the present invention which is frustoconical in shape. The converter is positioned in a system as previously and can be interposed in an exhaust or produced
5 as an add-on to the end of an exhaust. The shape of the converter increases the cross sectional area of the honeycomb core through which exhaust gases must pass.

With respect to Figure 5 of the drawings, the small muffler illustrated comprises a split casing (typically a metal casing) generally indicated by arrow 10.

An exhaust inlet 11 is positioned on a rear wall 12 of the casing.

10 Within the interiors of the casing, a mesh shield 13 is provided and a baffle plate 14.

Incoming exhaust fumes travel in the direction of the path arrows on the drawing and are delivered to an outlet pipe 15 which has an end cap 16.

A honeycomb core 17 is positioned within the pipe 15 and extends
15 substantially throughout the length of the pipe.

A ring of stainless steel mesh 18 at the entry portion at the pipe assists to locate the core 17.

The cap 16 (see figures 5a and 5b) may be provided with a plurality of vents 19 which deflect exhaust downwardly.

20 With respect to figure 6 of the drawings, a similar small muffler is provided except that the tube 17 extends partially into the interior of the casing 10.

Figure 7 of the drawings shows a further form of muffler according to the present invention where an exhaust inlet 11 is positioned centrally in the back wall 12 and a honeycomb core 20 occupies a first approximate half-section of the casing.

25 A baffle plate 21 is positioned downstream of the core 20 and the exhaust path again being indicated by path arrows.

With respect to figure 8 of the drawings, a marine outboard motor generally indicated by arrow 30 is provided with a catalytic converter 31 positioned between power head 32 and an exhaust passage 33 in the bag 34.

30 The converter 31 may optionally be positioned at "A" between the head 32 and the passage 33 and/or at "B" within the passage 33.

In the arrangement illustrated, treated exhaust gases are deposited in

open water via the passage 33 as indicated by the path arrows of figure 8.

With respect to figures 9 to 11 of the drawings, a catalytic converter is installed downstream of the exhaust muffler of a combustion engine.

In figures 9 and 10 of the drawings, a converter is provided with a tubular body 35 which is fitted onto an end pipe 36 of an exhaust system.

The body 35 houses a catalyst 37.

The end 38 of the pipe 36 is raked and a hinged flap 39 is fitted to the raked end as indicated. A suitable raking angle is approximately ten degrees.

A hinge 40 securing the flap is uppermost so that when an engine feeding an exhaust system is not running, the flap is closed.

The flap 39 may be "weighted" to suit particular installation situations.

When an engine is running at idle or road speed, the position of the flap and thus, the exhaust output varies depending on exhaust outflow.

At idle speed, the flap is partially closed restricting outflows and as a result, maintaining heat within the catalyst to ensure it is operable.

Figure 11 of the drawings illustrates a combination of a muffler 40, an end pipe 41, a catalyst 37 and a flap 39 as described in the previous embodiment.

The present invention is not only relevant to motor vehicles but also equally applicable to all engines using hydrocarbon fuels, e.g. diesel, two stroke and four stroke engines.

The significant advantage of the present invention is the reduction of undesirable output emissions for all engine types.

In the instance that the invention is applied to a small motor e.g. a lawnmower motor, the converter may be connected directly to an exhaust outlet or incorporated in a muffler device.

Aspects of the present invention have been described by way of example only and it would be appreciated that modifications and additions thereto can be made without departure from the scope of the invention.

DATED this 8th day of January 2004

Adrian Menzell
By his patent attorneys
Cullen & Co.

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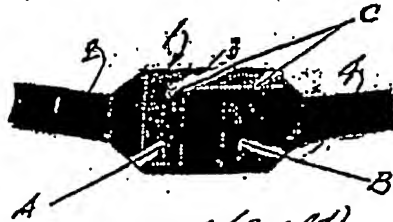


FIGURE 1 (Prior Art)

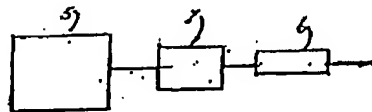


FIGURE 2 (Prior Art)

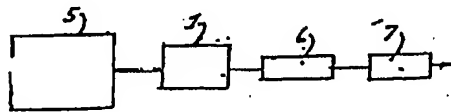


FIGURE 3

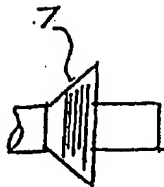


FIGURE 4a

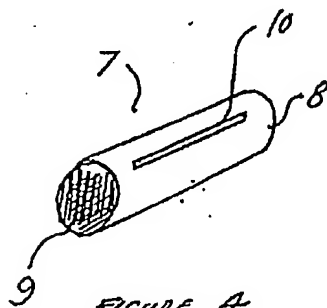


FIGURE 4

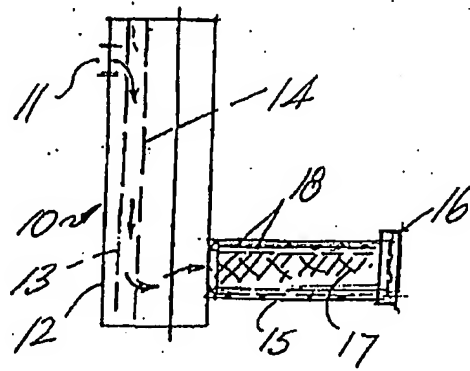


FIG. 5

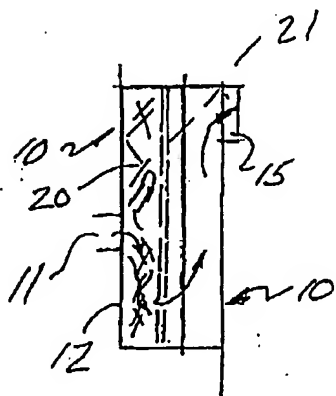
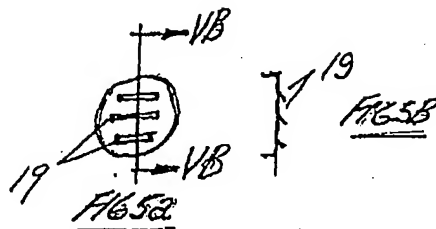


FIG. 7

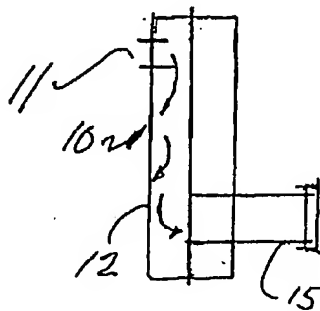
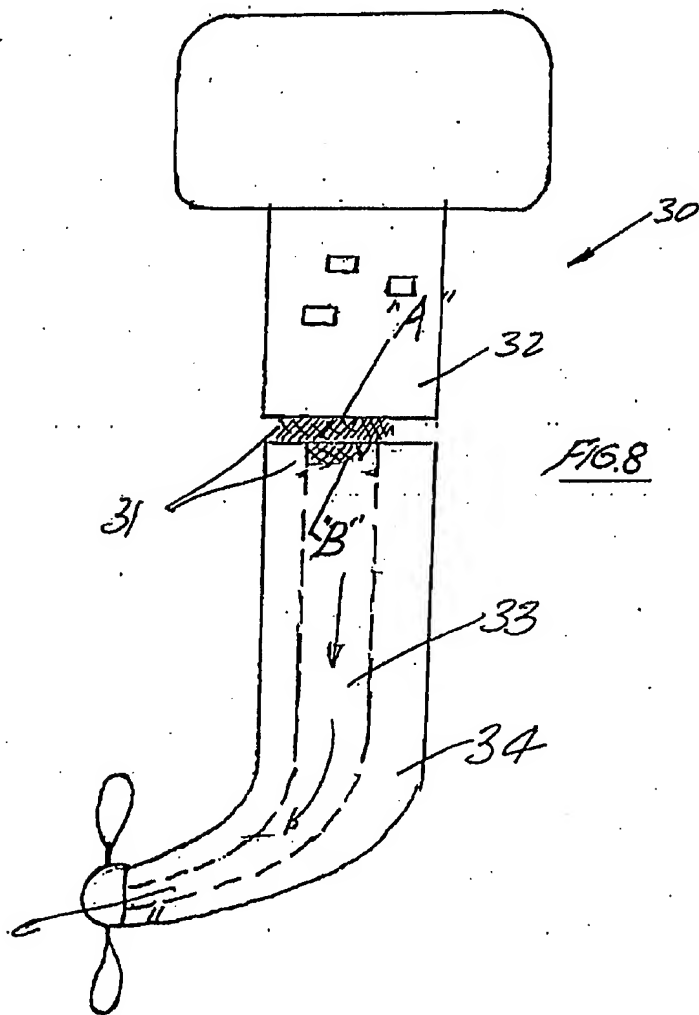


FIG. 6

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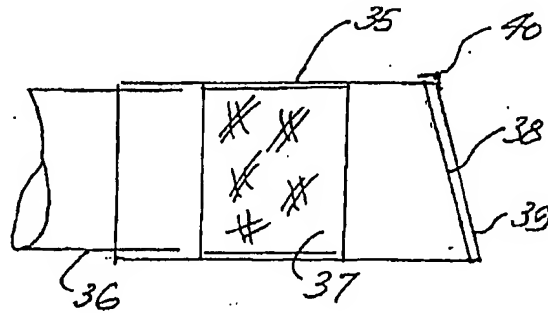


FIG 9

FIG 10

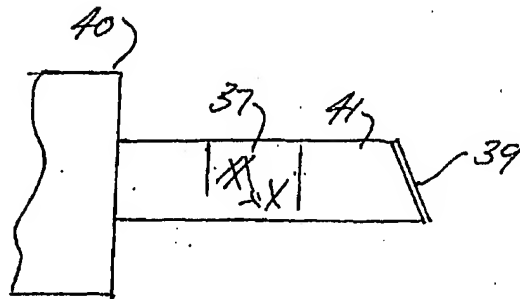
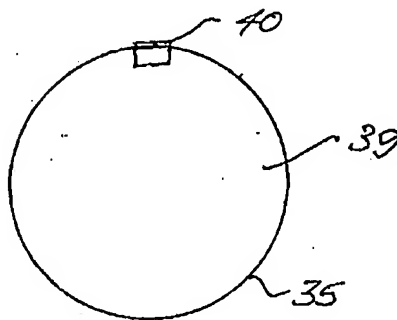


FIG 11